



Laptop Linux Machine configuration (2008-2012)

Configuring a 5-8 year old laptop to run Linux? This guide will show you how to avoid common compatibility problems that beginners commonly make.

Written By: Nick



INTRODUCTION

Guide Notes

- This guide does not cover component replacement (if needed).
- Your completion time will depend on how compatible your laptop is on stock hardware.
- If this guide is printed, a color printer is recommended.
- Some formatting in this guide is incompatible with the iFixit app.

Hardware

Age (Non-negotiable)

- Minimum: 2008
- Preferred: 2011-2012

CPU

Minimum processor requirements (Non-negotiable):

- Dual core
- 64-bit
- Must support 64-bit OS installation

Brand and Series (Negotiable):

Intel

- Best value: Core i3 (Sandy Bridge)
- Low cost: Core i5 (Arrandale)

AMD

APU

- Best value: Comal Fusion (Socket FS1r2/FP2)
- Low cost: Sabine (Socket FS1)

Non APU

- Best value: Turion II Dunabe (Socket S1G4)
- Low cost: Athlon II Dunabe (Socket S1G4)

Memory (Non-negotiable)

Capacity

- Minimum: 4GB
- Recommended: 8GB

Type

- Newest: DDR3/DDR3L
- Oldest (Hardest to find): DDR2

HDD/SSD (Negotiable)

HDD

- Minimum: 500GB
- Recommended : 1TB

SSD

- Minimum: 256GB
- Recommended: 512GB

Miscellaneous

Laptop battery recalibration

If the battery included with your laptop is older, it should be recalibrated as soon as possible.

To do this, charge the battery to 100% until the laptop no longer turns on. Fully charge the battery and check for runtime improvements.

WARNING: If the battery gets too hot during recalibration, STOP and replace the battery!

Note: Some laptops will not turn on with battery power if the battery runs too low. Laptops with this protection method require a workaround to calibrate properly.

IGP compatibility

Intel

- Intel HD Graphics: Works out of the box.
- Intel GMA: May require Non-Free firmware.

AMD

- AMD (APU): Non-Free firmware required.
 - AMD (Non APU): May require Non-Free firmware.
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TOOLS:

- [Usb Flash Drive](#) (1)

Used for installation of Linux

- [DVD](#) (1)

Only use if you have a system with USB boot problems or have no extra USB drives you can format

- [CD-R](#) (1)

Used for PlopKExec and Plop Boot Manager

Step 1 — Legacy BIOS hard drive warning



⚠ Legacy BIOSes and hard drives >2TB: Legacy BIOS systems do not properly address hard drives >2TB. This is due to a 32-bit addressing limitation. **Important:** The only way to fix this is a UEFI BIOS upgrade.




Step 2 — System selection/HW change



- Before the guide starts, this is the hardware I chose for this guide:
 - Model:
 - RAM: 8GB
 - Hard drive: 500GB (WD5000BEVT)
 - CPU: Intel Core i5 2520M
 - GPU: Intel HD Graphics 3000/nVidia NVS 4200M (Optimus enabled)
 - WiFi: Intel Centrino Advanced-N 6205

Step 3 — Memory (RAM)



-  The amount of memory you install determines how well your system performs. The minimum recommended amount is **8GB**.
-  Memory listed here is commonly available. If you intend to keep your system for years, stick to systems with commonly available memory.
- **DDR3L:** The main advantage DDR3L offers is reduced operating voltage. However, most DDR3L modules are backwards compatible with systems that run at 1.5V. **Tip:** Most pre-2011 systems are not DDR3L-Aware. This may cause compatibility issues with some legacy systems.
 - **DDR3:** DDR3 was first supported in laptops by Intel, starting with the GL/GS chipsets in 2008. While Intel continued to support DDR2 until 2011 with the 2nd gen Core i series, AMD chose to support DDR2 exclusively until 2011.
-  While memory in this section can be purchased, availability is limited. **Systems in this group are not ideal for users who want to keep their system long term.**
- **DDR2:** While DDR2 can be purchased, most brick and mortar retailers do not sell it due to limited demand. It is often easier to purchase memory for these systems online. **Note:** In most cases, DDR2 will be more expensive than DDR3.

Step 4 — Solid State Drive (SSD)



⚠ Some SSD's have Linux specific issues. If the SSD you are considering has known issues, make sure the problem is fixed or blacklisted in the kernel.

⚠ The drive in the picture has [known TRIM issues](#). These issues were never fixed and had to be blacklisted.



ⓘ Most Linux distros do not enable TRIM automatically. While most distros use the same procedure, this is not always the case.

- **128GB:** Due to the limited capacity of these drives, these should only be OS drives.
- **256GB:** While these drives are small, they may be sufficient for users with limited local storage needs. **Note:** Users with large local storage needs should consider these OS drives.
- **512GB:** While these SSD's are still expensive, they have become much more affordable. **Note:** SSD's with MLC flash suffer from a slight performance penalty.
- **1TB - >1TB:** In the consumer space, SSD's >512GB still have a high \$/GB cost. It may be better to wait for the prices to come down before buying these drives.

Step 5 — Hard drive (New)/ Need pictures



 **Seagate hard drives have had reliability problems since the 7.01 series.**

-  Buy the best hard drive you can afford. Purchasing the same drive your system came with is not cost effective.
-  If you have access to the original hard drive, take a note of the following data for your records (Note: S/N is optional): **Capacity, Brand and Date of Manufacture (DOM).**
- **Low cost:** If you are on a budget and can't afford a high performance hard drive, look into the **WD Blue 1TB (\$50)**. WD Blue drives do not last as long as Black drives, but are a good value for the price.
- **7mm laptops:** If your laptop can only accept 7mm hard drives, the **WD Black 500GB (\$53)** is the best option. These are not as cost effective, but will fit in laptops that are too thin for 9.5mm hard drives.
- **9.5mm laptops:** If your laptop accepts 9.5mm hard drives, the **WD Black 1TB (\$65-69)** is the best option. The reason for this is the 1TB drive has a lower \$/GB cost then the 750GB drive.

Step 6 — Hard Drive (Used)



⚠ Business class systems: If your system includes a hard drive, budget for a replacement hard drive. However, most business remove the hard drive.

⚠ Hard drive testing: If you reuse the hard drive your system came with, perform the following tests:

Wear/tear: Check the Power on Hours and Power on Count.

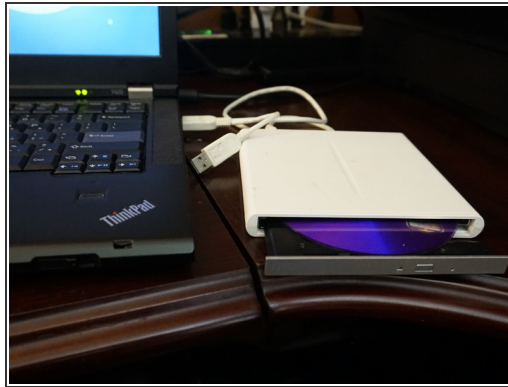
General problems: Run a SMART Extended Self-test. **Optional:** Run a surface scan on the drive.

★ While these tests will detect most issues, intermittent issues may not be detected. **Tip:** If you determine the hard drive is heavily used, it should be replaced (even if it works).

- **250-320GB:** While these drives are still produced, they are less common than they used to be. Since these drives are obsolete, many of them are heavily used.
- **500GB-1TB:** Generally speaking, drive condition is usually age dependent. If the drive is fairly new (<5 years old), the drive is likely serviceable. However, older drives (>5 years old) are likely to have age related problems.

- **>1TB:** These drives are similar to the 500GB-1TB group. Newer drives (<5 years old) are likely serviceable. However, older drives (>5 years old) are likely to develop age related problems.

Step 7 — Optical drive



✦ Most users do not use the DVD drive in their laptop regularly. However, testing is still recommended. **Tip: If the optical drive in your laptop does not work, consider installing a dummy if you do not need an internal optical drive.**

- **DVD Recorder:** These are the most common type of optical drive. Modern optical drives work with + and - media, so media type is generally not an issue.
- **Blu-Ray:** Blu-Ray drives are somewhat uncommon. While some systems have Blu-Ray drives from the factory, most are user installed. In most cases, you will find that the drive is a BD-ROM (Reads Blu-Ray, but reads/writes to DVD).

Step 8 — Wireless (No Whitelist)



i Laptops on this list can accept any compatible wireless card. **Note:** If your laptop is older, you may need a [half to full height bracket](#) to install a modern wireless card.

- **Dell:** While Dell does not use whitelists, most laptops ship with Dell branded wireless cards. In Linux, Dell QCA cards are preferable. **Tip:** Intel wireless cards offer the best out of the box compatibility in Linux.
- **Alienware (Dell):** Since Alienware is owned by Dell, these laptops do not have a whitelist. **Tip:** Many Alienware laptops ship with Killer wireless cards. While these cards work, some have known issues.
- **Common brands (Asus, Acer, MSI, Samsung, LG, etc.):** In the overwhelming majority of cases, laptops in this group DO NOT have a whitelist.
- **Private label (Puget Systems, System76, etc.):** Private label laptops are manufactured by companies like Clevo and Sager for companies like System76. Whitelists are not practical for these laptops.

Step 9 — Wireless (Whitelisted)



These laptops only accept "authorized" wireless cards. Unless your laptop boots with the card disabled, it must be removed.

- **Lenovo:** For all intents and purposes, Lenovo laptops have a whitelist. Most Lenovo laptops halt POST and display an 1802 error if an unauthorized card is installed. **Tip:** Some Lenovo laptops will boot with unauthorized cards disabled.
- **HP Business (2005-2012):** While newer HP Business laptops (2013+) are not whitelisted, 2005-2012 systems are. Whitelisted laptops are unlikely to receive a retroactive BIOS update.
- **HP Consumer (2007-present):** HP has whitelisted consumer hardware since 2007. This affects the majority of HP Consumer laptops. **Tip:** If you know what to look for, some HP systems were never affected. These laptops are not well known.

Step 10 — Wireless (Compatibility)



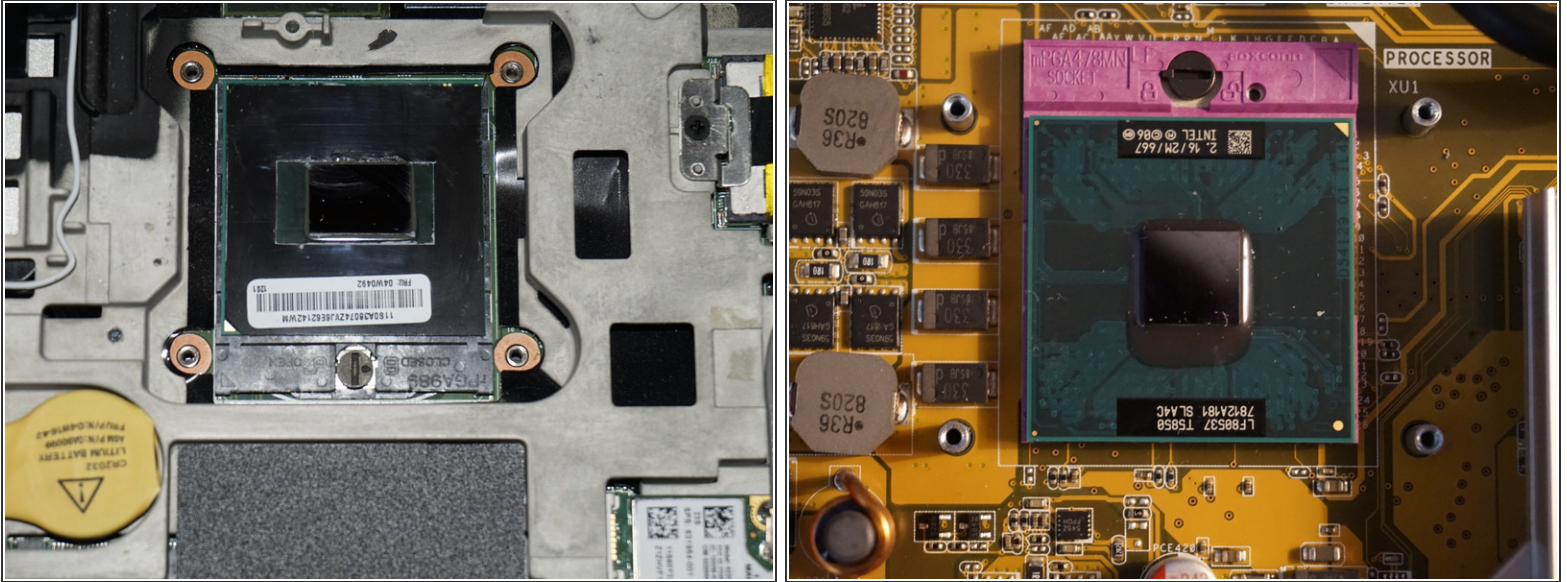
⚠ In Linux, it is important to select the right wireless card. If your wireless card has compatibility problems, Linux specific issues are very likely.

⚠ If your wireless card is **NOT dual band (2.4/5GHz compatible)** and **lacks 802.11n support**, the card should be replaced.

- **Intel:** Most Intel wireless cards work perfectly in Linux. **Tip:** Intel requires Non-Free firmware in Linux. For distros like Debian, firmware will need to be sourced separately from your installation media.
- **QCA/Atheros:** Most QCA cards are very reliable in Linux. While I have not tested any ath10k cards, I have had good luck with ath9k cards. **Tip:** ath10k cards require Non-Free firmware.
- **Realtek:** Realtek wireless cards are hit and miss. I have found that most Realtek wireless cards work best in distros like Ubuntu and Linux Mint. However, other distros can be a gamble.

- **Azurewave:** Azurewave wireless cards are based on manufacturer reference designs. Compatibility is largely chipset dependent. **Tip:** QCA cards are the most compatible. While ath10k cards require Non-Free firmware, Linux compatibility is excellent.
- **Ralink:** Ralink was known for poor Linux support. Ralink is now owned by MediaTek for their IP. **Note:** As Ralink's Non-Free firmware ages, compatibility issues are likely to develop.

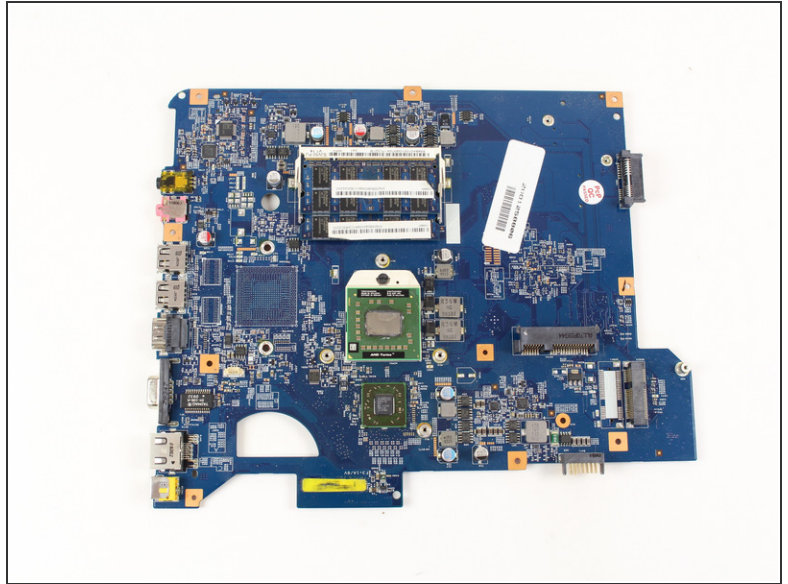
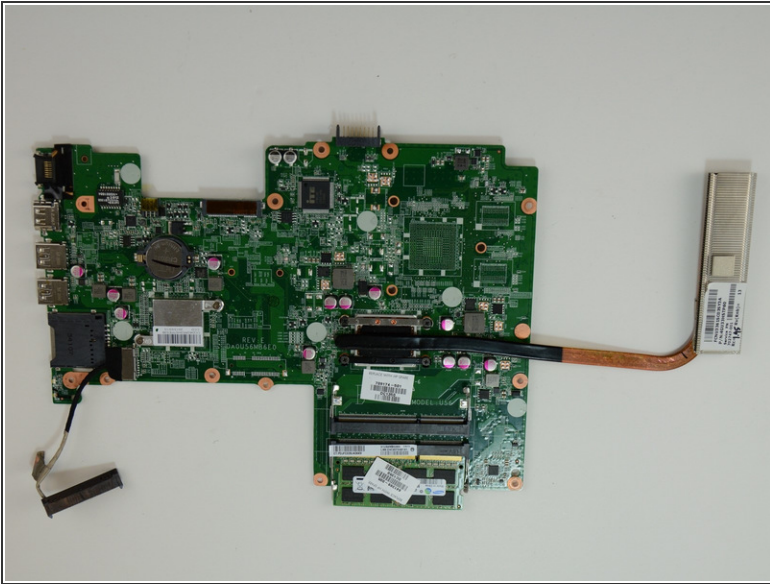
Step 11 — Processor (Intel)



i This list is not fully inclusive. **If your processor is not mentioned, most low end processors were omitted.**

- **Core i Series 3rd gen (Ivy Bridge):** While these laptops are uncommon, used systems are becoming more common. However, these systems often come at a higher price.
- **Core i Series 2nd gen (Sandy Bridge):** Secondhand laptops that use these processors are very common. While most laptops with this processor are business class, consumer grade systems are also common. Generally speaking, system prices are determined by what hardware is installed.
- **Pentium (Sandy Bridge/Ivy Bridge):** Pentium processors are only one step above Celeron processors. The low end nature of these processors makes them hard to recommend unless you are on a budget that does not permit anything better.
- **Atom (N570/N2800):** Most Atom netbooks have limited usability. The main reason for this is RAM (2GB maximum). However, the N2800/N570 officially support 4GB of RAM.
- **Core i Series 1st gen (Arrandale):** Before settling on these laptops, price out a Pentium laptop first. These laptops are usable for basic tasks, but most laptops with this processor only came with Intel HD Graphics (1st gen).
- **Core 2 Duo (T8/T9/P series):** Most Core 2 Duo laptops made in 2008-2009 are still usable for basic tasks. However, these laptops are no longer suitable for processor intensive work. **Note:** When these laptops fail, it is typically more cost effective to replace the whole system.

Step 12 — Processor (AMD)

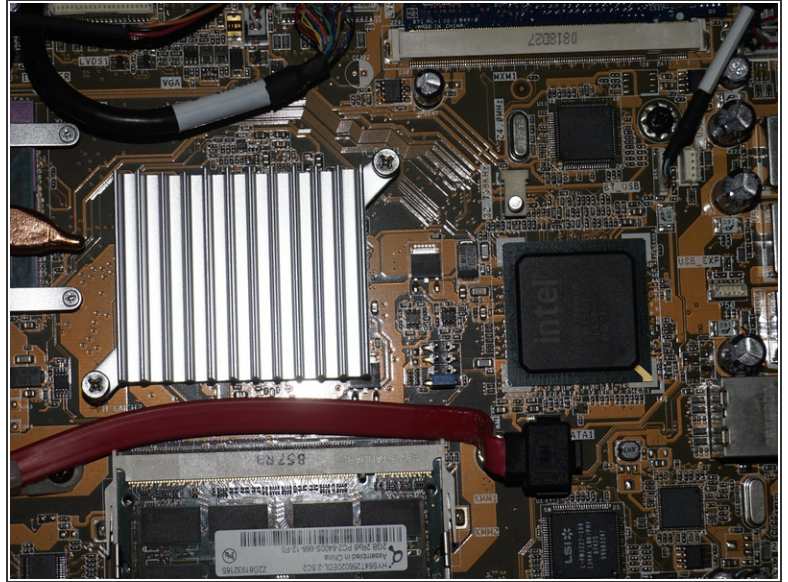
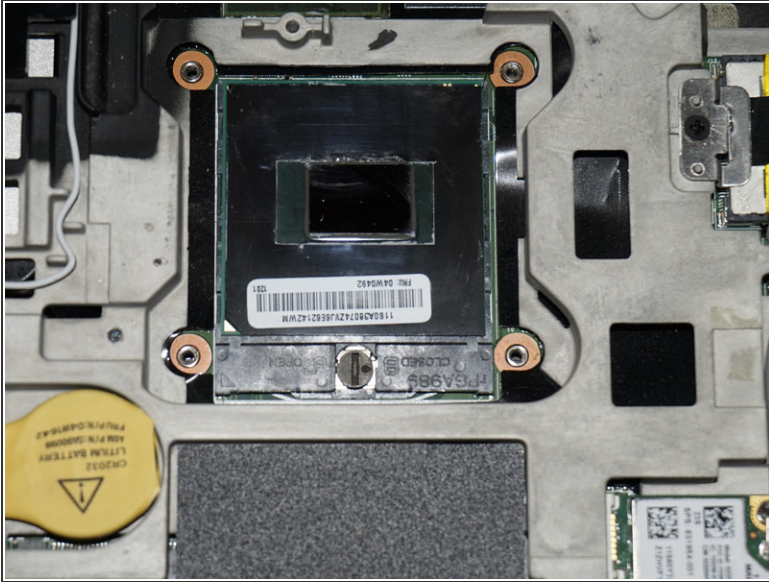


- **Comal (Fusion) FS1r2/FP2 (2012):** The AMD Fusion platform is made for mainstream laptops. All processors are dual/quad core. **This platform uses Radeon 7xxxG Series graphics.**
- **Sabine FS1 (2011):** The AMD Sabine platform is primarily used for midrange processors. While A6/A8 laptops are okay, E2/A4 laptops are generally unusable after 3-4 years. **This platform uses Radeon 6xxG Series graphics.**
- **Brazos (2011):** The AMD Brazos platform was primarily designed for netbooks. With the exception of 2 processors (C-30/E-240), all other processors are dual core. **This platform uses Radeon HD 6000 Series graphics.**
- **Danube S1G4 (2010):** The AMD Dunabe platform was made for mainstream notebooks. With the exception of the V Series, all other processors are dual/quad core. **This platform uses Radeon HD 4200 Series graphics.**
- **Nile ASB2/BGA812 (2010):** The AMD Nile platform is intended for Ultrathin laptops. With the exception of 3 processors (Athlon II K125/145/V105), all other processors are dual core. **This platform uses Radeon 4200 Series graphics.**

 **These platforms only support DDR2 memory. DDR3 is NOT supported.**

- **Tigris S1G3 (2009):** The AMD Tigris platform was used in mainstream laptops. With the exception of 3 processors (Sempron M100/120/140), all other processors are dual core. **This platform uses Radeon HD 4200 Series graphics.**
- **Congo ASB1 (2009):** The AMD Congo platform was released for Ultraportables. This platform was never used with single core processors. **This platform uses Radeon 3200 Series graphics.**

Step 13 — Integrated graphics



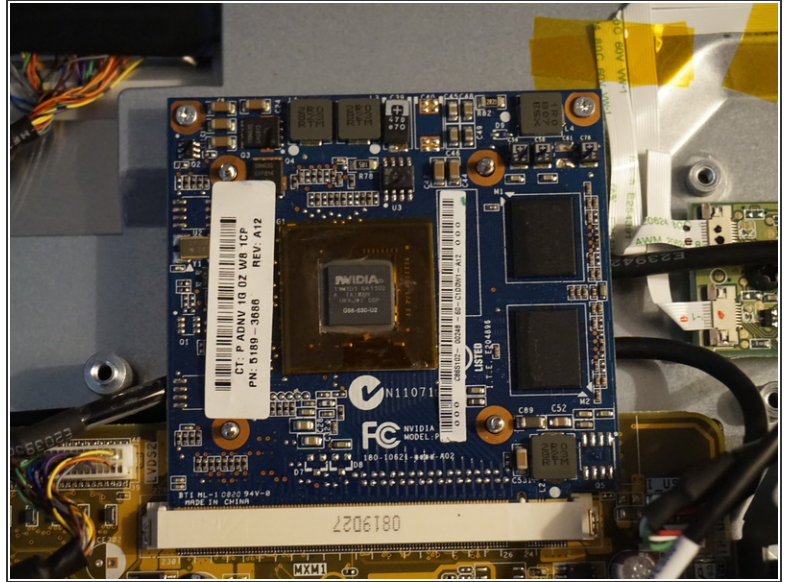
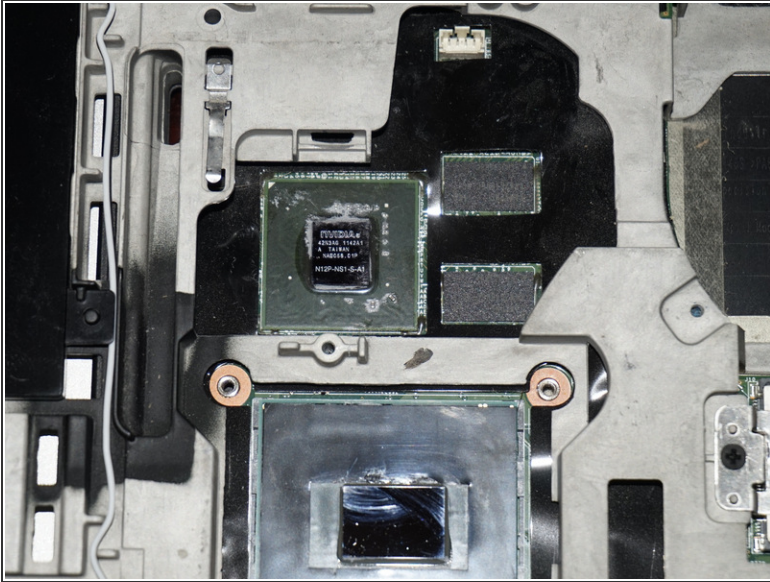
⚠️ Laptops with dual graphics can be troublesome in Linux. If you are considering one of these laptops, check if this feature can be disabled in the BIOS.

- **Intel HD Graphics (2010-present):** Intel HD Graphics are integrated into the processor. While performance for basic tasks is acceptable on later generations (2000/3000/2500/4000), this was not the case with the first generation.
- **AMD Radeon G Series (2010-present):** AMD Radeon G Series graphics are integrated into AMD A Series APU's. These processors also integrate the northbridge and southbridge. Your system's performance will depend on when the processor in your laptop was released.

⚠️ Hardware on this list is several years old. While it can still be used for basic tasks, there will be a noticeable performance gap.

- **ATI Radeon HD 5000 Series (2010):** The Radeon 5000 Series was AMD's last GPU without APU options. Once the 6000 Series was released, AMD began transitioning to only releasing APU platforms. This platform is only good for basic tasks today.
- **Intel GMA Graphics:** Intel GMA chipsets are known to work well in Linux, in part due to Intel releasing chipset documentation and drivers. The problem is many older chipsets are unusable due to age. **Note:** PowerVR chipsets (500/600/3600/3650) REQUIRE Non-Free firmware.

Step 14 — Dedicated graphics



- **AMD (Non-Free firmware REQUIRED)**

- **Radeon:** AMD Radeon graphics cards are designed for consumer use. Since these cards are marketed for consumer use, Linux may not be fully supported. However, AMD Linux support is much better.
- **FirePro:** AMD FirePro cards are made for high end workstations where ISV certifications are important. Since these are professional cards, they are designed to work well in Linux.

- **nVidia (Non-Free firmware required for the best performance)**

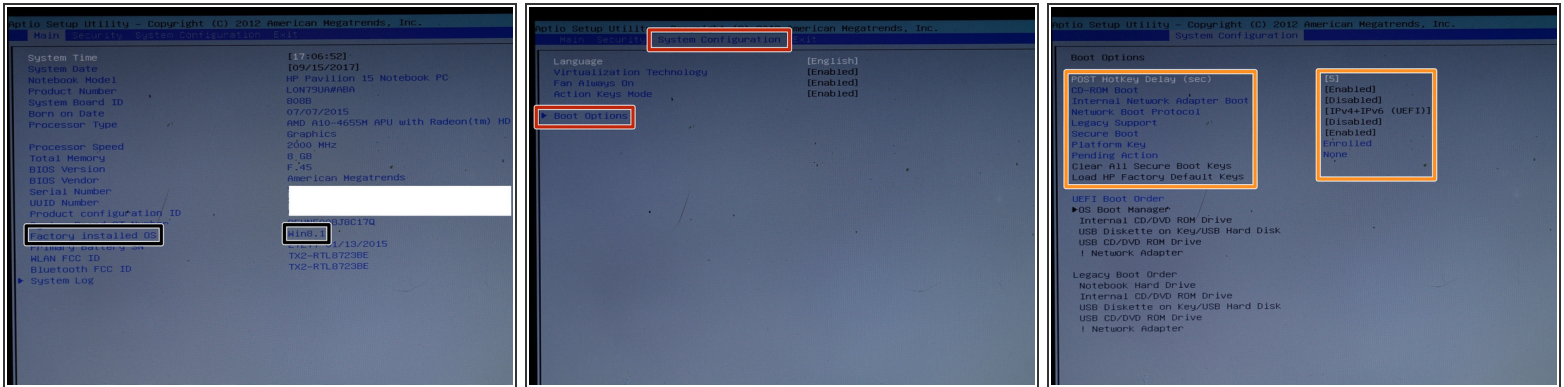
- **GeForce:** nVidia GeForce cards are known for mediocre Linux compatibility. nVidia focuses more on proprietary API support (Ex: DirectX, Gameworks, PhysX), which hurts performance in Linux.
- **Quadro:** nVidia Quadro cards are made for high end workstations where ISV certifications are important. Just like AMD FirePro cards, these cards are designed to work well in Linux.




Step 15 — Media



- ✦ For the majority of readers, USB install media is recommended. While DVD media is useful for systems with poor USB boot implementations, this problem is not common.
- i** **USB creation:** If you need help making a USB boot drive, refer to [this guide](#).
- i** **CD boot manager options:** [PlopKExec \(Designed for Linux\)](#) or [Plop Boot Manager \(Linux compatible\)](#)
- **USB:** For most readers, USB installation is preferable. This is primarily because of used laptops with bad optical drives and compact laptops that do not have optical drives. **Important:** If you plan on using FDE, plug in a second USB drive for decryption key retention.
- **DVD:** Most readers should skip this option. The DVD option should only be considered when it is your only option or you are having problems booting from USB.
- **Boot manager (Backup):** If you want to use a USB flash drive on a system with difficulty booting from USB media directly, this is a tried and true workaround. **Note:** For the overwhelming majority of users, this option will be redundant.

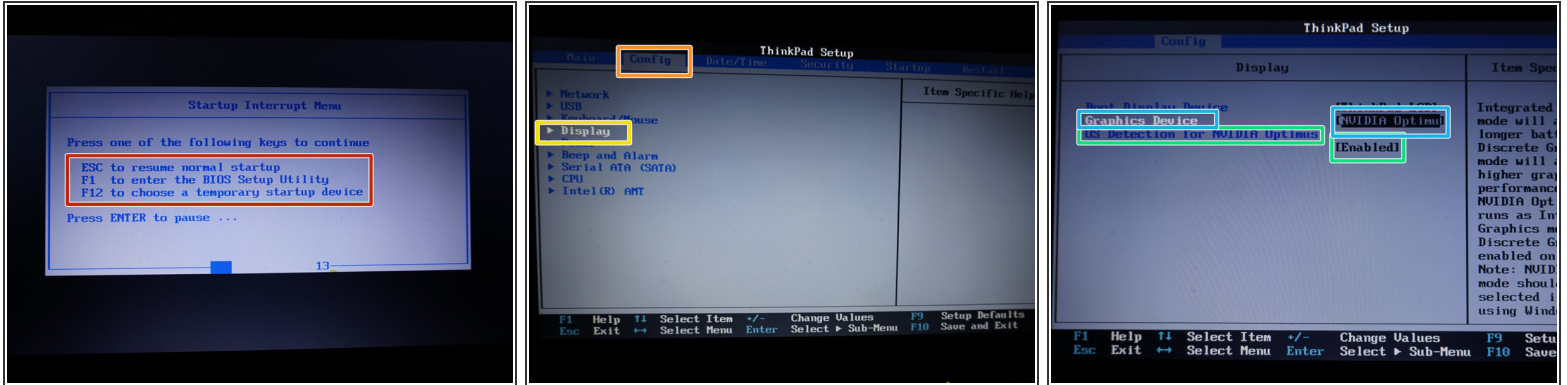
Step 16 — How to disable Secure Boot



-  These steps only apply to systems that ship with Windows 8.x installed.
-  These steps only apply to reference UI AMI (American Megatrends) BIOSes. They do not apply to custom BIOSes (Ex: Dell DMI).
-  These steps were developed on an HP Pavilion 15-p263nr. While this laptop is not used, the BIOS used is similar to many other systems.

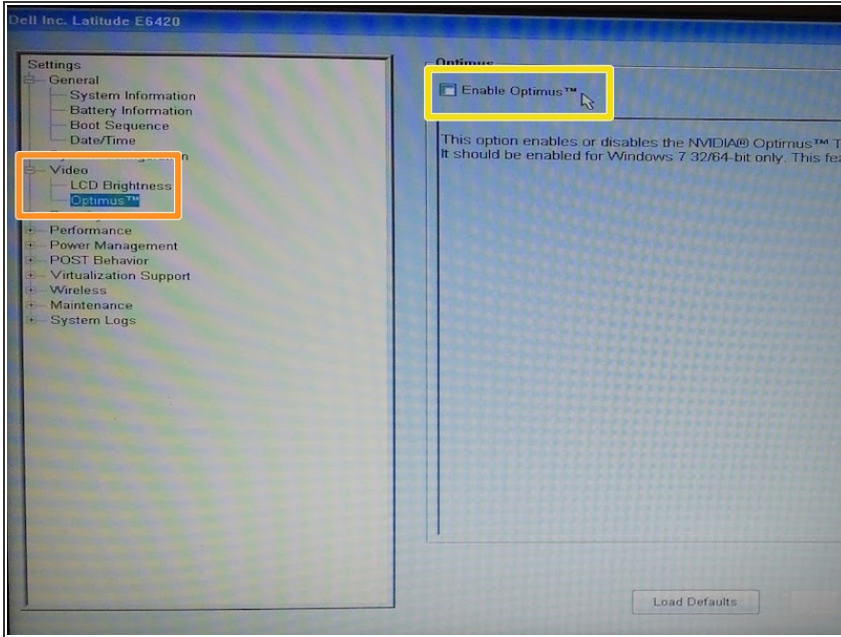
- **Option 1 (One time boot menu):** To access the boot menu, press **Esc or F12**. This will load the boot options menu on most systems. The time to do this can vary, so you may miss it the first time. **Note:** Some systems use a less common key. If your system does this, check Google.
- **Option 2 (Direct BIOS access):** To access the BIOS directly, press **F10 or F11**. These two keys will cover most systems. **Note:** Some systems use less a less common key. If your system does this, check Google or use the boot menu.
- Press the right arrow button on your keyboard. Find the **System Configuration** submenu and press **Enter**. Make the following changes:
 - Disable **Secure Boot**. Press **Enter** and change this setting to **Disabled**. **Note:** Depending on what distro you use, the Legacy Boot Option ROM may need to be enabled.
 - Once you make these changes, save your changes and exit the BIOS. The computer will now allow you to boot from any installation media.

Step 17 — Managing nVidia Optimus (ThinkPad)



- i This step only applies to Optimus enabled ThinkPads.
- ★ If you used install media that lacks bundled Non-Free firmware, nVidia Optimus will need to be configured manually. Disable this feature if you do not want to do this.
- To disable nVidia Optimus:
 - Load the system BIOS. This can be done by pressing **F1**, using the **Boot Menu (F12)** or the **Startup Interrupt Menu (ThinkVantage button)**.
 - Once the BIOS is loaded, find the **Config** tab in the BIOS.
 - Once you are in the Config menu, find the **Display** submenu. Press **Enter** and make the following changes:
 - Disable **OS Detection for NVIDIA Optimus**. To do this, press **Enter** and change this to **Disabled**.
 - Once Optimus is disabled, you will need to select one GPU to run at all times. The GPU you pick is up to you.

Step 18 — Managing nVidia Optimus (Dell Business)



⚠ Image source: [Dell Community](#)

❗ This step applies to Optimus enabled Latitude, Vostro and Precision systems. **Note:** Some laptops have this option, but require a newer BIOS to enable it.

★ If you used install media that lacks bundled Non-Free firmware, nVidia Optimus will need to be configured manually. Disable this feature if you do not want to do this.

- Press **F2** to direct BIOS access. If you want to do this through the One-Time boot menu, press **F12**.
- Open the **Video** submenu and find **Optimus**. Make the following changes:
 - Find the **Optimus** submenu. Disable the feature by unchecking the box next to **Enable Optimus**.
- Once Optimus is disabled, save the changes to the BIOS. Your system will default to using nVidia graphics.

Step 19 — Distros (Good)



☑ Since there thousands of Linux distros, I cannot list them all. **Note:** I have saved line space by condensing similar distros into a single group.

- ***buntu:** This is a catch-all section for the Ubuntu distro family. Despite many similarities between distros, system requirements will vary. **Typical lifecycles: 5 years (LTS)/6 months (rolling release).**
- **Linux Mint:** Linux Mint uses Ubuntu packages and base code. While Linux Mint is a good distro, the default browser favors search engines with referral links. However, this is easy to change if you do not want to be tracked.
- **Linux Mint Debian (LMDE):** LMDE primarily uses Debian packages and Debian base code. It is also updated with new releases less frequently. These are the primary differences LMDE have.
- **Debian:** Debian is considered an intermediate distro. While Debian is more advanced, it is not as difficult to use as distros like Gentoo. Many distros use Debian as a starting point, so there are a lot of similarities. **Note:** Since Debian is an intermediate distro, protections like +x blocks are less aggressive.

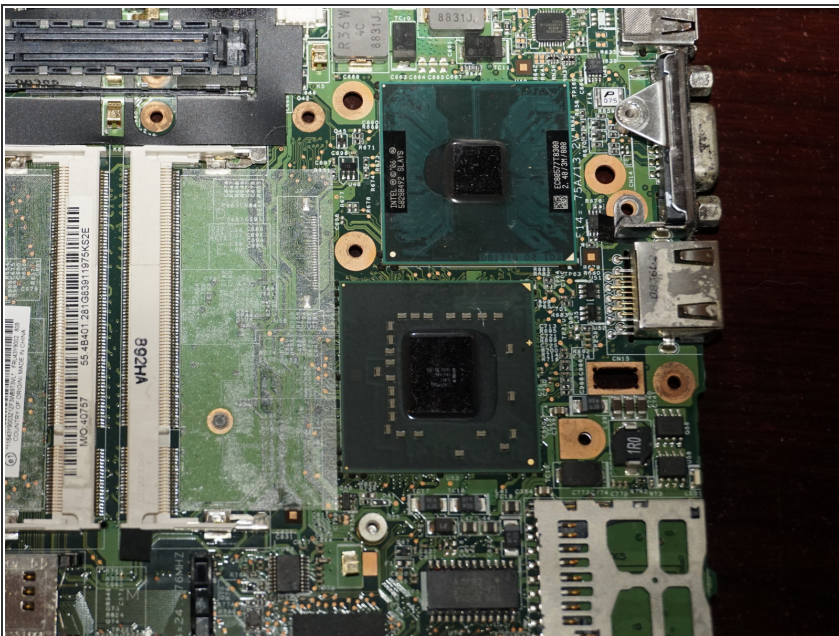
Step 20 — Distros (Bad)



i Distros on this list are **not recommended**. To provide some context, the issue I have with the distro is listed as part of the non-recommendation.

- **Ubuntu (Unity): Note: Partially phased out.** I have not recommended Ubuntu since 12.10 was released. Ubuntu 17.10 fixes the Amazon problem by reducing the Amazon integration to a (easily removed) web link. I still do not recommend 16.04 LTS since this uses Unity (and retains the persistent module).

Step 21 — Chipset (Deprecated)



! This step is preserved for reference only.

i AMD processors made within the past 7 years integrate the northbridge into the processor. Intel has done this since 2010.

★ This is not a catch all group for every chipset. I have only covered a handful of chipsets and is generalized.

- **Intel:** Outside of a few obscure chipsets, the vast majority of Intel chipsets work in Linux without any issues. **Note:** Linux tends to work best with first party chipsets. While 3rd party chipsets work, your mileage will vary.
- **AMD:** While AMD made their own chipsets, these are primarily found in OEM systems. Most retail boards use VIA chipsets (with the exception of some high end boards that use an AMD chipset).
- **VIA:** VIA chipsets are known to have excellent Linux compatibility. On top of this, VIA also provides firmware for Linux users. **Tip:** Distros like Debian typically require manual installation of such firmware.
- **nVidia nForce:** While nVidia left the chipset market in 2010, some of these systems are still in service. The problem is these systems weren't supported very long and were typically only supported for ~1 year.

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